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## ISOTOPIC COMPOSITION OF BULFUR IN METEORITES AND TERRESTRIAL OBJECTS

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In the Institute of Geochemistry and Analytical Chemistry imeni V. I. Vernadskiy, A. Trofimov recently completed a study of the isotopic composition of sulfur in meteorites and terrestrial objects (1). Nier's determination of the isotopic composition of terrestrial sulfur in 1938 (2) showed that it has four stable isotopes in the following percentages:  $S^{32}$  (95.1),  $S^{33}$  (1.74),  $S^{34}$  (4.2), and  $S^{36}$  (0.016). Since that time, no invertigations had been made of the isotopic composition of sulfur.

Trofimov studied four sulfur specimens taken from two aerolites (Saratov and Grosslibental') and two siderites (Augustinovka and Sikhote-Alin:). Four specimens of terrestrial sulfur were also taken for comparison: Greenland sea water, elementary volcanic sulfur obtained from Klyuchevskaya Sopka, pyrite, and reactive sulfuric acid. The analysis was conducted using a mass spectrograph (with a spread of 90 degrees) similar to the type constructed by Nier (3) and Hipple (4). The concentration of isotopes was determined by measuring the ionic currents with an amplifying tube baving a maximum sensitivity of approximately  $1 \cdot 10^{-15}$  amperes per millimeter on the scale of a mirror galvanometer. The ionic beam was controlled by changing the accelerating field but, in distinction to Nier's work, errors from the "volt effect" were determined and corrections for it were introduced in the final results. Samples of sulfur dioxide, SOo, were prepared from these specimens to carry out the analysis. During ionization of the gas in the ion source, effected by electrons with energies of approximately 60 ev, SO2 ions emerged besides a smaller-quantity of SO and S ions. Each of them from a group of peaks corresponding to all possible combinations of sulfur and oxygen isotop's. However, both the SO2 and the S ions fell in the regior of mass values for which a background appeared after introduction of the gas. This background could not be eliminated, and its distorted the picture of the isotopic distribution. In the region of masses for the SO ions, between 48 ( $\rm S^{32}0^{16}$ ) and 52 ( $\rm S^{34}0^{16}$ ), the vacuum background was absent even for prolonged continuous operation of the instrument, and the picture of the peaks was reproduced well in

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repeated measurements. Therefore, determination of the isotopic composition for all samples was carried out only on the SO ions. Two series of independent measurements were carried out at different times. The ratio of S<sup>34</sup> to S<sup>32</sup> was determined with an error not exceeding one percent, and the ratio of S<sup>34</sup> to S<sup>32</sup> with an error not exceeding 3 percent. With regard to the very rare isotope g<sup>35</sup>, it could only be shown that it had similar concentrations in all samples. The averaged results of the measurements, compiled with consideration for the influence of various oxygen isotopes and corrections for the "volt effect," are presented in the table below.

Meteorites	s32:s33:s34	Terrestrial Objects	532:533:53h
Saratov	100:0.78:4.53	Sea water	10010.81:4.60
Grosslibental'	100:0.79:4.56	Volcanic sulfur	100 : 0.81:4.56
Augustinovka'	100:0.79:4.56	Pyrite	100:0.80:4.56
Sikhote-Alin'	100:0.79:4.54	Sulfuric acid	100:0.79:4.56
Average	100:0 79:4.55	Average	100:0.80:4 57

It is seen from the table, first, that the isotopic composition of sulfur is the same in all four meteorites and that the average isotopic composition of terrestrial and meteoritic sulfur is almost identical, as it is for the other elements which have been studied up to now, and, second, that the proportion obtained for sea water proved considerably different from all others in its indication of carichment by the heavy isotope S34. This enrichment constitutes approximately one percent, i.e., it is almost within the limits of possible measuring error, but is apparently real since it was observed for all measurements. The very fact that sea water is enriched by the heavy isotope confirms the probable existence of some process which is responsible for its enrichment. Finally, since the measurements described were twice as accurate as Nier's and the number of measurements was considerably larger, the average proportion of sulfur isotopes calculated on the basis of this table (\$32:\$3-3:\$3-1 = 100:0.80:4.56) is more accurate than that given by Nier, which is listed in all isotope tables (11:0.78:4.4).

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